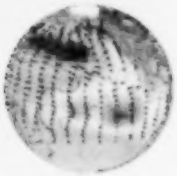
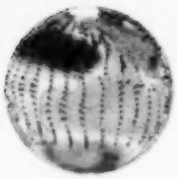
Archive of Columns



Sea change underway in Pacific



Column 413
by Claire Eamer

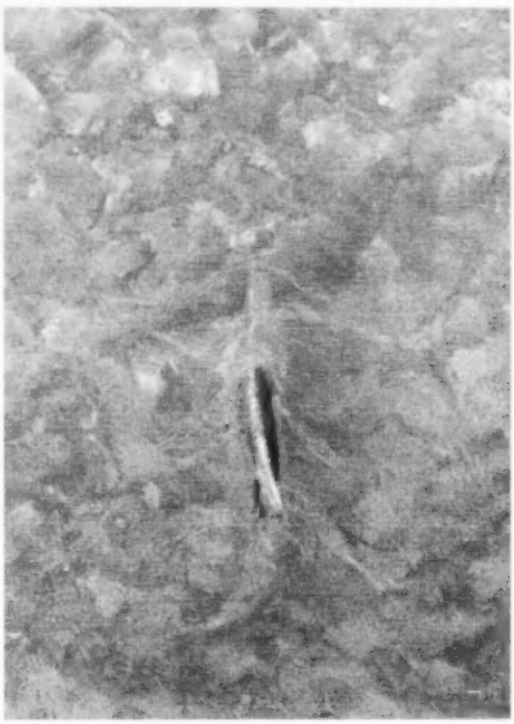
In the 1980s and 1990s, Alaskan fishing vessels hauled in record-breaking catches of salmon. At the same time, low salmon runs sometimes led to the complete shutdown of fishing in southern British Columbia and the northwestern United States.

Twenty years earlier, the fishing luck had been reversed, with southern fishing nets full and Alaskan nets empty.

Washington fisheries researcher Steven Hare thought there might be more to the pattern than fisherman's luck. As part of his thesis research in the 1990s, he looked back in time, linking historical fishing records with information about climate and ocean conditions in the north Pacific.

Hare found a pattern that he dubbed the Pacific Decadal Oscillation, or PDO. Every two or three decades, the northern part of the Pacific Ocean appears to undergo a major shift in temperature, wind, and current patterns.

During what Hare called a cool or negative phase, winds over the North Pacific tend to blow west and warmer ocean water shifts west toward Asia and northwest around the tip of Alaska into the Bering Sea. At the same time, cooler water flows along the west coast of North America, as far north as the Gulf of Alaska.



Pacific salmon, like these at Klukshu in the southwest Yukon, provided an important clue to the Pacific Decadal Oscillation.

(photo: C. Eamer)

During a warm or positive phase, the pattern is reversed. A huge mass of cooler water fills most of the North Pacific basin, with warmer currents hugging the coasts of Oregon, Washington, British Columbia, and southern Alaska.

The shifts in temperature and currents affect microscopic organisms that form the basis of the ocean's food chain, ultimately affecting the survival, growth, and migration patterns of major marine species like salmon.

The process is complex, but the result for the fishing industry is fairly simple. Alaskan salmon do well in a positive phase of the PDO; Pacific Northwest salmon do

2008-04943/

well in a negative phase.

Nothing else about the Pacific Decadal Oscillation is simple. The pattern of shifting water masses and temperatures is much larger than Hare's original study indicated, affecting the entire Pacific Basin almost from pole to pole.

It might, in fact, extend all the way to the North Pole, says Environment Canada climate scientist Paul Whitfield.

"The PDO is certainly real and many things appear related to it, but it may actually be an artifact of the Arctic Oscillation," he says, referring to a recurring pattern in the Arctic Ocean.

A similar but better-known repeating pattern in the Atlantic, the North Atlantic Oscillation, might also be a product of the Arctic Oscillation, he adds.

The shifting ocean regimes happen over huge areas of the planet, but their effects and the evidence that reveals them to us can be surprisingly local. Changes in the ocean are linked with changes in weather patterns over land, including in the Yukon. Weather patterns, in turn, affect how plants and animals thrive and develop.

Those effects can be tracked. At roughly the same time that fishing records led Steven Hare to deduce the Pacific Decadal Oscillation, Japanese researchers studying tree ring patterns reached the same conclusion.

Since changes in weather patterns affect agriculture and other economic sectors, understanding what drives processes like the PDO could make long-term planning more reliable. Climate scientists are working on the problem, but they haven't solved it yet, says Whitfield.

"Some climate features such as El Niño and the Arctic Oscillation have a clear physical mechanism, but others such as PDO are not so clear."

It is also not entirely clear what phase of the PDO we are currently experiencing. The last clear change was in 1976-77, when the PDO shifted from negative to positive, bringing joy to Alaskan fishers and hard times to those further south. Now it appears to be shifting again.

"The index has crossed the zero boundary between positive and negative, so it looks like it is shifting, but we can't predict," says Whitfield. "This is sort of like being between a field of grass and a forest. We are not really in the field, but we aren't in the forest either."

For more information about the Pacific Decadal Oscillation, go to tao.atmos.washington.edu/pdo.

Environment Canada
Pacific and Yukon Region